ART. XXV.—*Glaucoma: its Causes, Symptoms, Pathology and Treatment.* By PRIESTLEY SMITH, Ophthalmic Surgeon to the Queen's Hospital, Birmingham. With lithographic plates. 8vo. pp. xv., 281. London: J. & A. Churchill, 1879.

THE subject of glaucoma is almost a perennial one for discussion in ophthalmological literature, as might be expected when we recollect that its pathology is still in an unsettled state. Mauthner and Schnabel have recently given us several articles upon the subject, and now the author of the present work comes forward with a treatise on glaucoma of 280 pages, illustrated by numerous plates, to which the Jacksonian prize for 1878 was awarded by the Council of the Royal College of Surgeons.

The work is divided into seven sections, under which are considered the etiology, estimation of tension, symptoms, pathology, and treatment of the disease. Smith recognizes the division of glaucomatous diseases into primary and secondary, though this may, perhaps, on scientific grounds, prove hereafter untenable. He includes under the term glaucoma all states of the eye characterized by an excess of tension.

Section I. is devoted to the consideration of the etiology of the disease, in which primary and secondary glaucoma is taken up separately. A very correct distinction is made between the two forms. The influence of advanced life, heredity, nerve disorders, especially neuralgiæ, the gouty diathesis, and hypermetropia are considered, the latter condition being recognized as present in the majority of cases of primary glaucoma. This greater liability of hypermetropic eyes to the disease is probably owing to the excessive thickness and prominence of the ciliary muscle. The author does not credit the connection of neuralgia of the trigeminus with glaucoma as an expression of perverted nerve influence producing persistent hypersecretion, and considers that the part played by the ordinary forms of facial neuralgia in causing glaucoma is not one of primary importance. He takes up Schmidt-Rimpler's investigations upon the peripheral irritation of certain branches of the fifth nerve, but dissents from some of his conclusions. In general terms it may be said that many things which have been numbered among the causes of glaucoma, but which are not really causes, may excite the malady even in a non-glaucomatous eye, provided those fundamental changes, which predispose to it, are already present.

In considering the special etiology of secondary glaucoma, the subject is prefaced by the assertion that "glaucoma, occurring as a complication of other maladies of the eye, is not generally attributable, as formerly supposed, to irritative hypersecretion, but to obstructed outflow of the intra-ocular fluid, caused by altered relations of the iris," and within certain limits this may be regarded as true. The statement that "the danger of glaucoma in anterior synechiæ reaches its maximum in cases of incarceration of the iris in extensive cicatrices of the cornea" may be questioned; it is certainly not the experience of the reviewer. The influence of posterior synechiæ, particularly to complete adhesion of the pupillary margin, in producing glaucoma, is very justly emphasized. In extraction of senile cataract, cases have been known where fragments of the cortex have proved a source of glaucomatous complications, and here Smith thinks that rupturing of the posterior capsule lessens this danger.

The general subject of etiology is somewhat briefly considered, but the observations are generally carefully made.

Section II. treats of the subject of "Tension" and its proper estimation, and begins with the axiom that "the essence of glaucoma is an increase of the intraocular pressure." Smith calls attention to the fact that displacement of the fluid in the eye is modified by various circumstances, such as variations in the elasticity of the sclera, and in the size and form of the eye, and variations in the curvature of the sclera at the point of impression. The relative accuracy of measuring the depth of the impression from the surface or from the chord of the arc, the author has endeavoured to solve by experiment, and the results led him to adopt the former method. Another point to be considered in taking measurements is the variations in the fulness of the intraocular vessels.

Smith then describes the tonometer invented by himself, and considers very carefully its action and method of application to the eye, and the description is accompanied by lithographic drawings. He gives the results of carefully conducted experiments undertaken to ascertain how tonometrical errors, due to asymmetry and varying size of the eye, might best be avoided, and as the natural outcome of his investigations concludes that the tonometer can never yield any but approximate indications.

Under Section III. are considered the symptoms of glaucoma, and in it glaucoma is itself regarded as a complex symptom. The description of absolute glaucoma and the ultimate results of the disease are exceedingly well given. Then follows an analysis of the symptoms, in which occurs a description of an apparatus constructed by the author, by which the living eye may be subjected to a pressure of known amount, variable at pleasure, for any desired time, while the subjective and objective examination may be carried on at the same time. The diminished sensibility of the cornea, often observed in acute attacks, Smith attributes to the stretching of the nerve fibres due to the pressure.

In speaking of the dilatation and inactivity of the pupil in this disease, the author refers to the subject of hypertrophy of the arterial walls under increased resistance to the propulsion of the blood, and calls attention to the fact that such hypertrophy has actually been demonstrated to exist in the arteries of glaucomatous eyes. He suggests that this may be the reason why, under a gradual rise of pressure, the blood-supply to the iris is maintained unimpaired; while, when a sudden stress falls upon the external surface of the comparatively yielding, healthy arteries, their calibre is so far diminished as to induce arterial emptiness in the iris, and consequent dilatation of the pupil. This idea has been mentioned before, and is probably the correct one.

In considering the venous pulsation on the optic disk, its limitation to a small central portion of a retinal vein, its frequent absence in glaucoma, and its frequent presence in eyes of normal tension, Smith offers the following explanation: When a main arterial trunk crosses a main vein near the margin of the disk, the dilatation of the former compresses the latter in such a way as to favour the collapse of its central portion. This tendency to collapse is greatly increased by any condition which tends to check the force of the stream at the distal end of this portion, near the margin of the disk. This, he thinks, explains the collapse of the small portion of the vein immediately adjacent to the aperture in the optic disk, synchronously with each arterial pulsation.

In Section IV. we have Part I. of the Pathology of Glaucoma. The author reviews briefly the physiological and pathological facts connected with glaucoma. He considers the subject of the normal intraocular pressure, and describes his own method of arriving at it. He then takes up the connection between the intraocular pressure and the blood pressure, and recognizes that though the former is lower than the latter, it is intimately dependent upon it, and he gives the results of experiments proving this.

The idea that the intraocular pressure is subject in some degree to the influence of the fifth nerve is an old one, on which von Hippel and Gruenhagen, Leber and Adamük have experimented again and again. Smith analyzes these experiments, contributes some of his own, and concludes that the presence in the trigeminus of special fibres, which by their action on the secreting cells, regulate the secretion of the intraocular fluid is still a moot point, though the fact that such fibres have been demonstrated in the salivary glands, is a point in favour of this view.

The author differs from Weber in believing it probable that the pressure in the aqueous chamber differs but little, if at all, from that in the vitreous chamber. He thinks that an equality of pressure, before and behind the lens and its suspensory ligament, can only exist upon the condition that this partition is incapable of yielding ; and he does not think either the tension of the suspensory ligament, or the pressure of the iris on the lens, or both, sufficient to admit of this resistance, for he proved by experiments on eyes removed from the orbits immediately after death, that this resistance of the ligament was practically *nil*. As regards the second point, the influence of the iris is either none at all or very slight, for in paralysis of the sphincter the lens has never been seen to advance.

The author next considers the physiological processes on which the intraocular pressure is dependent, and discusses briefly the points in Leber's admirable paper on "The Interchange of Fluids in the Eye." He dissents entirely from Knies's view that the true cause of glaucoma is a circumscribed inflammation of the tissues in the vicinity of Schlemm's canal, as a starting point of the obstructive changes, and he thinks it would be difficult to decide by the microscope whether the inflammation were the cause or the consequence of the disturbed relations of the parts.

He then discusses Weber's analytical papers on the physical conditions present in glaucoma, and gives the results of an elaborate and careful series of experiments by which he endeavoured to ascertain whether the obstructive changes at the angle of the anterior chamber might not be artificially produced under conditions which would preclude its dependence on swelling of the ciliary processes, namely in the excised eye. He found that an excess of pressure in the vitreous chamber equal to 5 cm. of water pressure or 4 mm. of mercury, sufficed to close the channel through which the aqueous humour normally escapes.

Another series of experiments proved that pressure on the posterior surface of the lens and suspensory ligament, unless counterbalanced by an equal pressure on the anterior surface, arrests the escape of the aqueous humour by compressing the angle of the anterior chamber ; and that this arrest occurs while a considerable quantity of aqueous humour still remains in the chamber, and while the chamber is still open peripherically, at least as far as the corneal margin, and probably rather farther. From the results of these experiments, and the conditions revealed by the microscope in glaucomatous eyes, he concludes : 1st. That the closure of the angle of the anterior chamber is the essential part of the glaucomatous process ; and 2d. It is dependent on or associated with exaltation of the vitreous pressure above the aqueous pressure, which does not exist in healthy eyes.

In opposition to the view usually entertained that the vitreous is nourished by a fluid secreted by the capillary plexus of the choroid, which reaches it by passing through the retina, Smith finds it improbable that a complex nervous structure like the retina, with an isolated vascular system of its own, should convey the secretion of an entirely different vascular tract on its one side to a structure with which it has nothing in common on its other side. Moreover, Kühne's discoveries render it almost certain that the function of the chorio-capillaris and the hexagonal epithelium is to secrete the "visual purple." Smith calls attention to the fact that the retina terminates at the ora serrata, and here begins an intimate connection between the uveal tract and vitreous, perfectly adapted for nutrition. It is highly probable that the vitreous body receives its nutrient supply exclusively from the ciliary portion of the uveal tract. He considers that detachment of the retina is more satisfactorily explained by this theory than by any other. Here the alteration in the vitreous is one either of malnutrition and consequent loss of bulk by atrophy, or of shrinking produced by inflammation and cicatrization of its tissue; and that the flow of albuminous coagulable fluid from the choroid is the natural result of the withdrawal from its vessels of the pressure to which they are normally subjected. In further support of his theory, he states that among a large number of specimens, there is no case of detached retina in which there is not marked disease of the ciliary body; and more important still, there is no instance of marked disease of the ciliary body without detachment of the retina.

Smith thinks it probable that the waste fluid of the vitreous body passes through the suspensory ligament into the aqueous chamber, and forming part of the aqueous humour, escapes from the eye at the angle of the anterior chamber, and some of his observations have been independently confirmed by Deutschmann. From his experiments on this subject, Smith formulates the following conclusions: 1st. The ciliary processes secrete the intraocular fluid. A portion of this fluid passes directly from the proportion of the processes into the anterior chamber. Another portion, proceeding from that part of their surface, which is in contact with the suspensory ligament, passes through this membrane into the vitreous chamber. 2d. The function of the suspensory ligament is probably purely a mechanical one—the maintenance of the lens in its proper position and the control of accommodation. 3d. The whole of the intraocular fluid, including that which returns from the vitreous, escapes from the eye at the angle of the anterior chamber. 4th. Under certain circumstances the pressure in the vitreous becomes greater than that in the anterior chamber by the retention in it of more than the normal bulk of fluid. When this occurs, the lens and the suspensory ligament advance so as to compress the angle of the anterior chamber, and retard or arrest the escape of the intraocular fluid. 5th. Glaucoma is the expression of this condition of obstruction.

In Section V. the subject of the pathology of glaucoma is further considered. The connection between glaucoma and senility is so close as to render it probable that the essential starting-point is to be found in the changes peculiar to advanced life. It is Smith's opinion that the tendency to glaucoma at this period depends on an abnormal relationship between the diameter of the lens and the diameter of the circle of the ciliary processes, and hence the hypermetropic eye is peculiarly liable to the disease.

In considering the connection of the vascular changes with his theory of glaucoma, Smith regards as untenable Leber's supposition, that the dilatation of the anterior ciliary veins is rather a result of inflammatory change than a pressure effect. He is inclined to indorse Weber's explanation, that the swelling of the ciliary processes, with dilatation of the anterior ciliary veins, is a natural and inevitable consequence of an increased intra-ocular pressure.

Two factors combine to produce a diminution of the distance which separates the margin of the lens from the ciliary processes: 1st. Increase in the diameter of the lens. 2d. Swelling of the ciliary processes. The former is usually the primary change, and is itself the indirect cause of the latter. Many of the author's observations on this point, and his conclusions drawn therefrom, agree with Weber's demonstrations.

The subject of the influence of iridectomy on glaucomatous eyes is then considered, and the manner in which it lowers tension discussed.

Assuming that his theory of the primary cause of glaucoma is correct, he thinks the operation has two distinct results; the opening of the angle of the anterior chamber, and the reopening of the space between the lens and the ciliary processes.

Several pages are devoted to a discussion of malignant glaucoma, of Weber's views of the so-called luxation forwards of the lens as its cause, and of his operation of puncturing the sclera for its relief. Smith has not had the successful results from the operation that Weber claims.

In criticizing the objections that may be urged against the obstruction theory of glaucoma, the author insists upon the point that closure of the angle of the anterior chamber is the cause of glaucoma, provided, 1st, that the secretion of the intraocular fluid be not so far suppressed as to render the distension of the eye an impossibility; 2d, that the intraocular fluid does not escape through some abnormal channel in sufficient quantity to neutralize the effect of the obstruction of the normal channel; and, 3d, that the closure affects a portion of the periphery of the chamber sufficiently extensive to materially retard the escape of the intraocular fluid.

In Section VI. we come to the treatment of glaucoma. The advantages and disadvantages of iridectomy and sclerotomy are fairly compared, and reference is also made to the various other operative measures which have been introduced at different times, and have since fallen into disuse.

In speaking of the employment of myotics on physiological grounds, Smith makes a good point in advising bedtime as one of the periods of application. During sleep the ciliary muscle is in a complete state of relaxation, and, if the form of the lens be really concerned in causing glaucoma, this unbroken period of rest must be a time of especial danger. The frequent onset of glaucoma during sleep is a well-known fact.

Finally, Section VII. contains an appendix of recorded cases, upon an examination of which his theory and ideas of pathology of the disease rest. Appended to this is a list of tonometrical measurements, which serve to show, among other points, how wide the limits of physological tension are.

The work is illustrated by a number of lithographs, plain and coloured; some of which are very good; particularly those representing microscopical sections of glaucomatous eyes.

The work is one which shows a large amount of faithful and careful work, with considerable ingenuity in the construction of apparatus necessary to the carrying on of the experiments, and a more than ordinary appreciation of the necessity of a careful consideration of the whole subject of tension. While some of the views advanced are not original, and have been already exhaustively discussed by other authors, there is still a good deal that is original in the manner of considering the subject and in the method in which it has been studied.

The bookmaker's work has been well done, the paper being firm and white, and the type clear, large, and provided with wide margins. The volume is one valuable both to the ophthalmologist and to the general practitioner. C. S. B.

Art. XXVI.—*Hygienic and Medical Reports.* By Medical Officers of the U. S. Navy. Prepared for publication under the direction of Surgeon-General of the Navy. By Joseph B. Parker, A.M., M.D., Surgeon U. S. Navy; Assistant to the Bureau of Medicine and Surgery. 8vo. pp. viii., 1079. Government Printing Office: Washington, 1879.

The publication of essays on medicine and hygiene, from reports of medical officers of the navy to the Bureau of Medicine and Surgery, was commenced December, 1872. The first, entitled "Contributions to Medical Science from the Bureau of Medicine and Surgery," contains ten papers. The second, "A Report on the Origin and Therapeutic Properties of Cundurango," a quarto volume, illustrated by twenty-two photographic plates, was published 1873. The third, "Sanitary and Medical Reports for 1873–74," was issued December, 1875; and the fourth, containing 70 reports and papers, was issued July, 1879.

In a prefatory statement Surgeon-General J. Winthrop Taylor (recently retired) says that the aim of these publications "is to improve the sanitary condition of our ships of war, and diffuse a knowledge of hygiene among the officers of the navy." As evidence of the necessity of greater attention to these matters he states that, "during the years 1876, '77, '78, it appears from the files of the bureau that 29,154 cases of disease were treated in a yearly average force of about 10,000; that 984 surveys were held (33—per 1000), and that 400 deaths were reported (13 + per 1000); a loss to the service of nearly 46 per 1000, as it can be supposed that only a small number of those surveyed returned to duty. By a more extended knowledge of hygiene it is hoped this large proportion can be reduced.

"During the same period there were 1273 applications from the navy for pensions; 638 claims were allowed." This implies an average annual loss in the naval service of 460 men, the pecuniary value of which is not estimated.

The volume consists of two parts. Part I., "Hygienic Reports," contains 46 reports from medical officers afloat, and tables of medical statistics of the navy for 1875, '76, '77, and '78, compiled by the editor, Surgeon Joseph B. Parker. The chief theme of all these reports is the same—the influence of deficient ventilation, and the unnecessary wetting of decks. The same story has been told in many ways to the authorities at Washington during much more than a half century, and seems never to have been heard by any of them, or rarely ever, if we may judge by the very few attempts made to remedy the evils complained of. The average air-space of sleeping berths for each man on board the several ships afloat, according to these reports, measures from 39 to 134 cubic feet, and the means of changing the air are entirely insufficient.